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GB 964974
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(54) Device for Regulating the Speed of a Vehicle

(57) Speed regulating apparatus for a vehicle uses one or more deceleration devices, such as a hydrostatic, hydrodynamic or eddy current brake, an engine inlet or exhaust throttle valve or an automatic gearbox, additional to the service brake system to maintain the speed at a preset value. The vehicle speed is compared with the reference value and the result of comparison preferably that a preset difference threshold is exceeded, used to bring into effect one or more deceleration devices. If several are employed these can be brought into use successively or if necessary all can be employed simultaneously. The vehicle may include an anti-skid braking system and components of that system used in the speed control apparatus. The apparatus may also use selectively the service brake system in addition to the deceleration devices. A receiving device, for example, radio signals may be provided to receive a reference speed for the vehicle from an external source, such reference speed being appropriate to the particular road conditions.

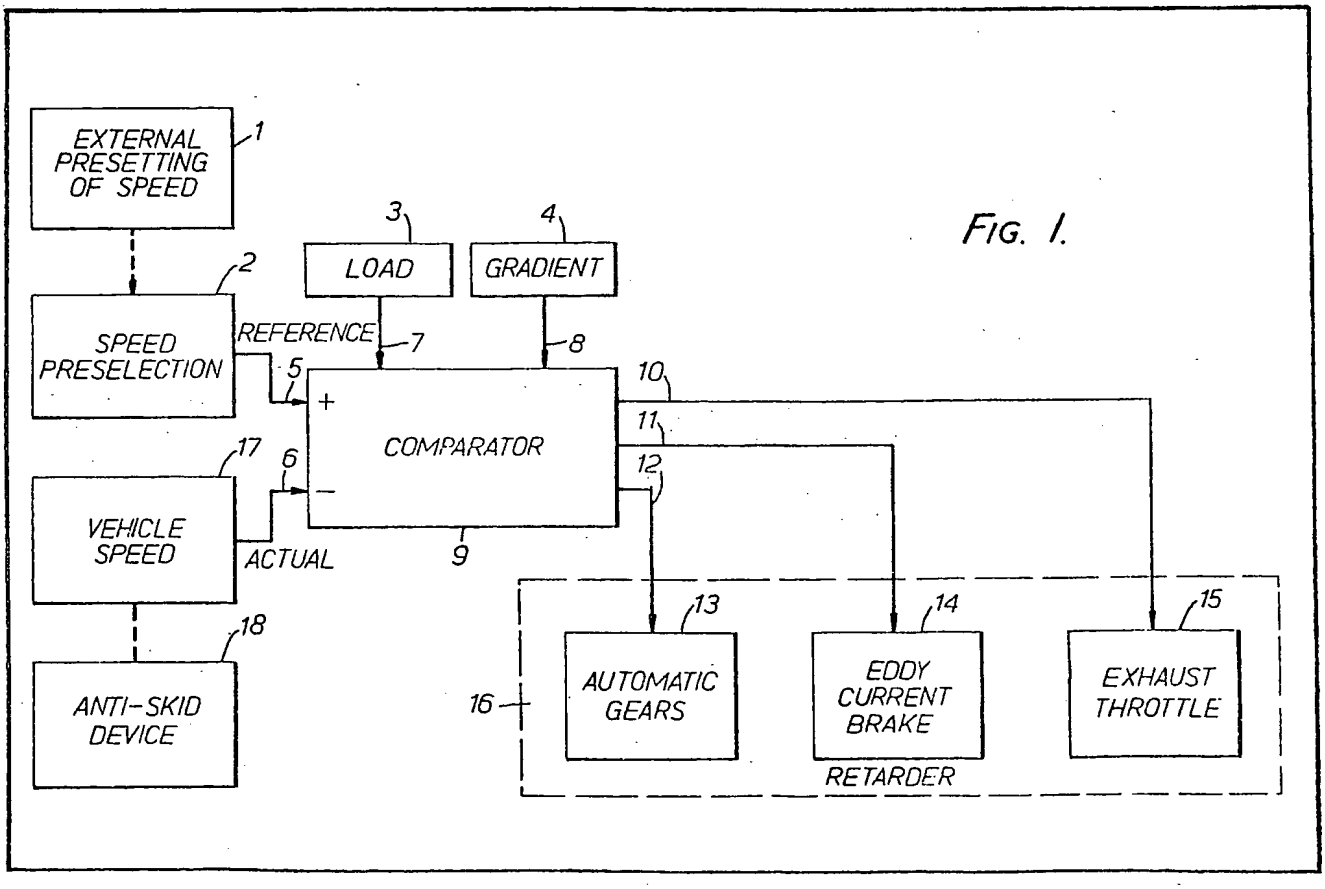

FIG. 1.

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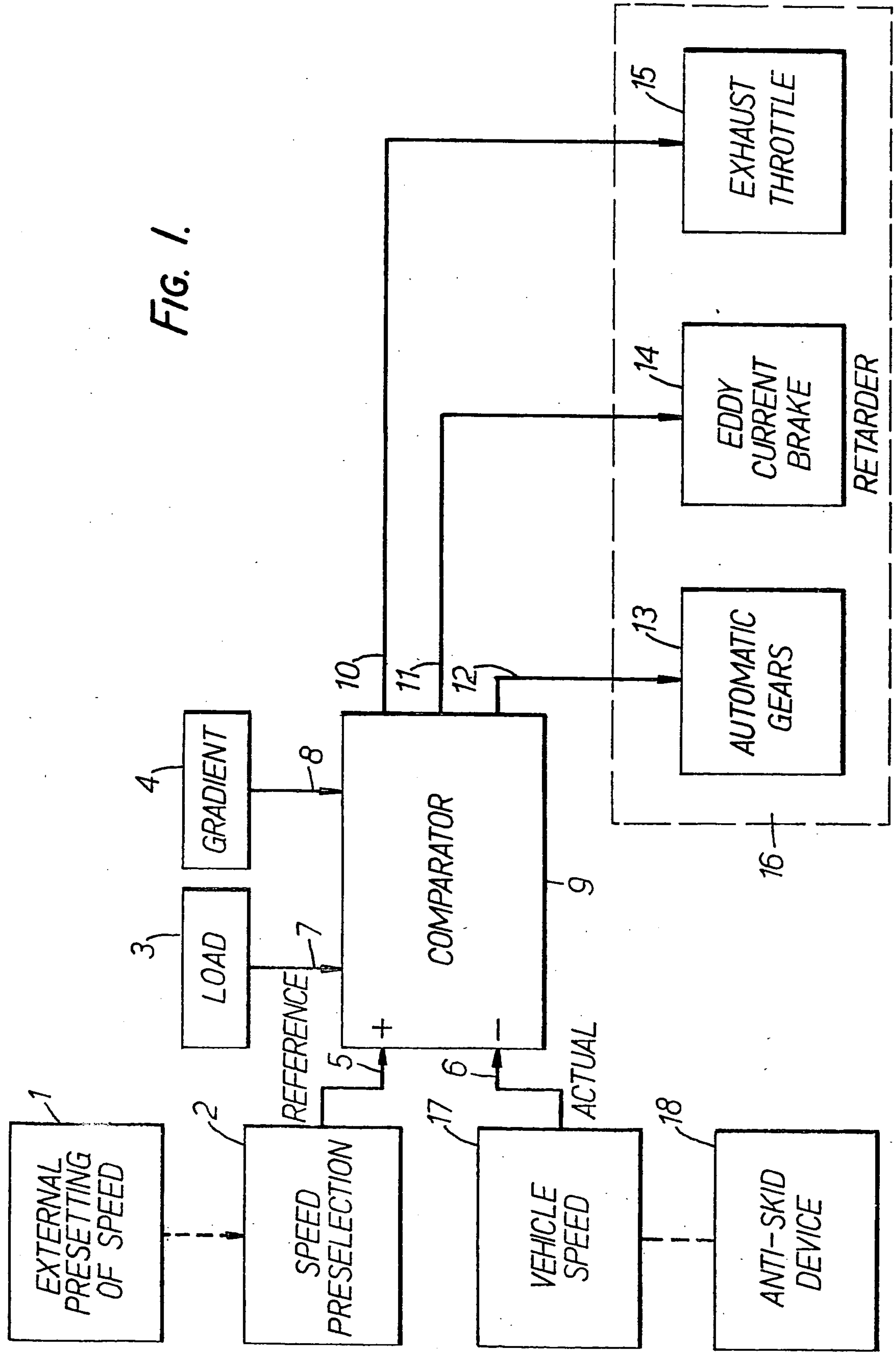
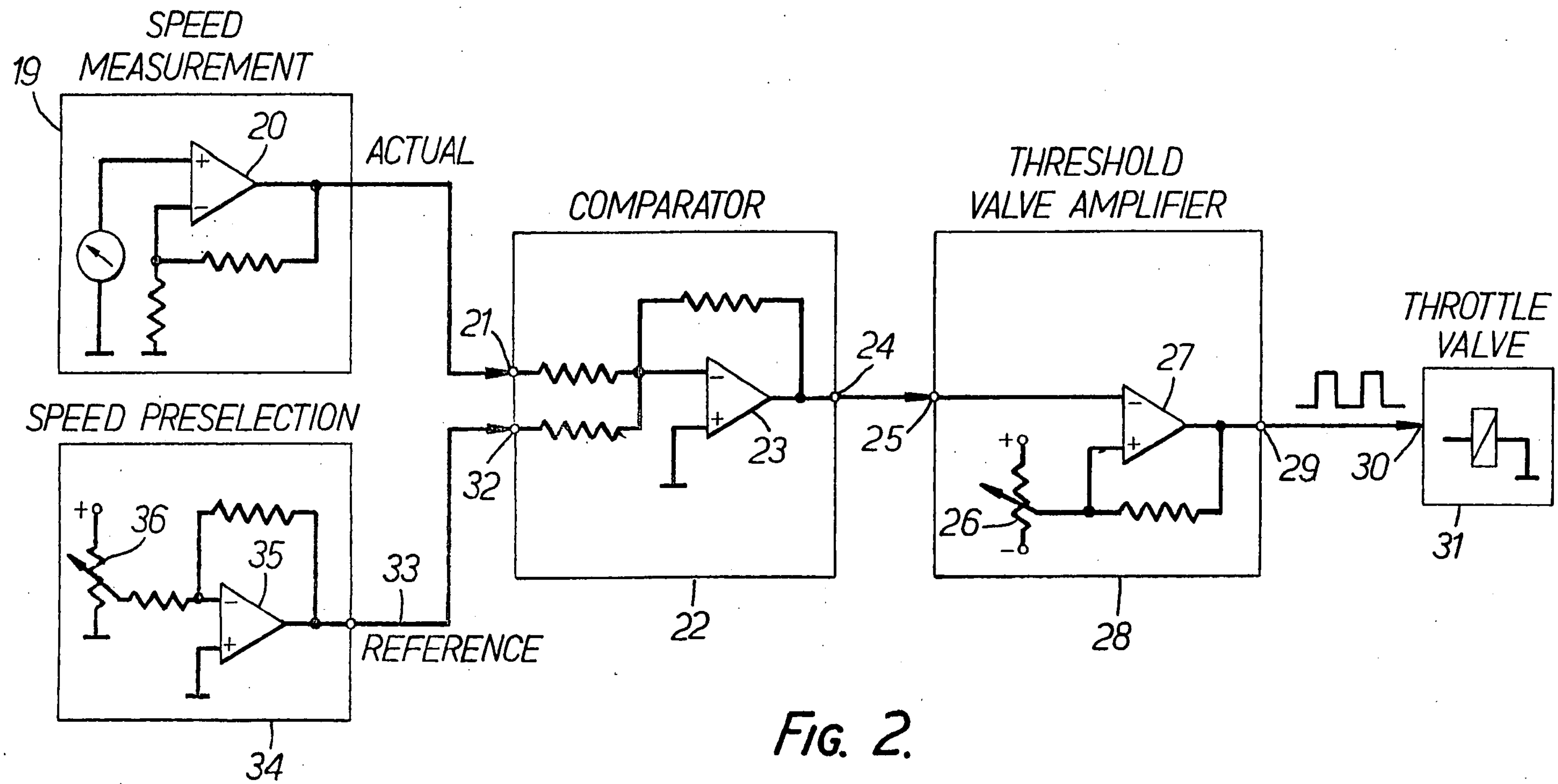


FIG. 1.


SPEED
MEASUREMENT
19
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ACTUAL
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VALVE AMPLIFIER
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THROTTLE
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SPEED PRESELECTION
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REFERENCE

FIG. 2.

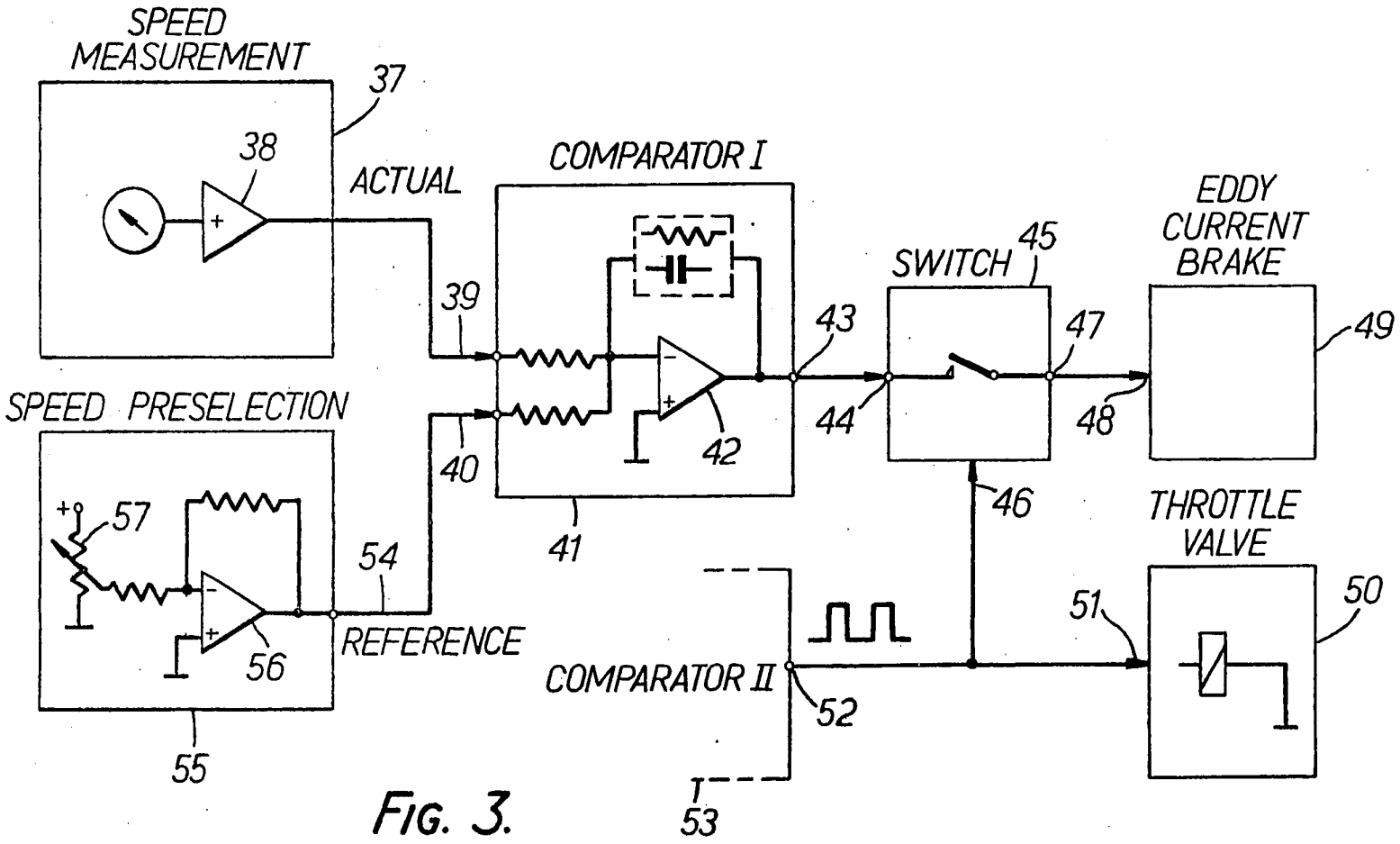

FIG. 3.

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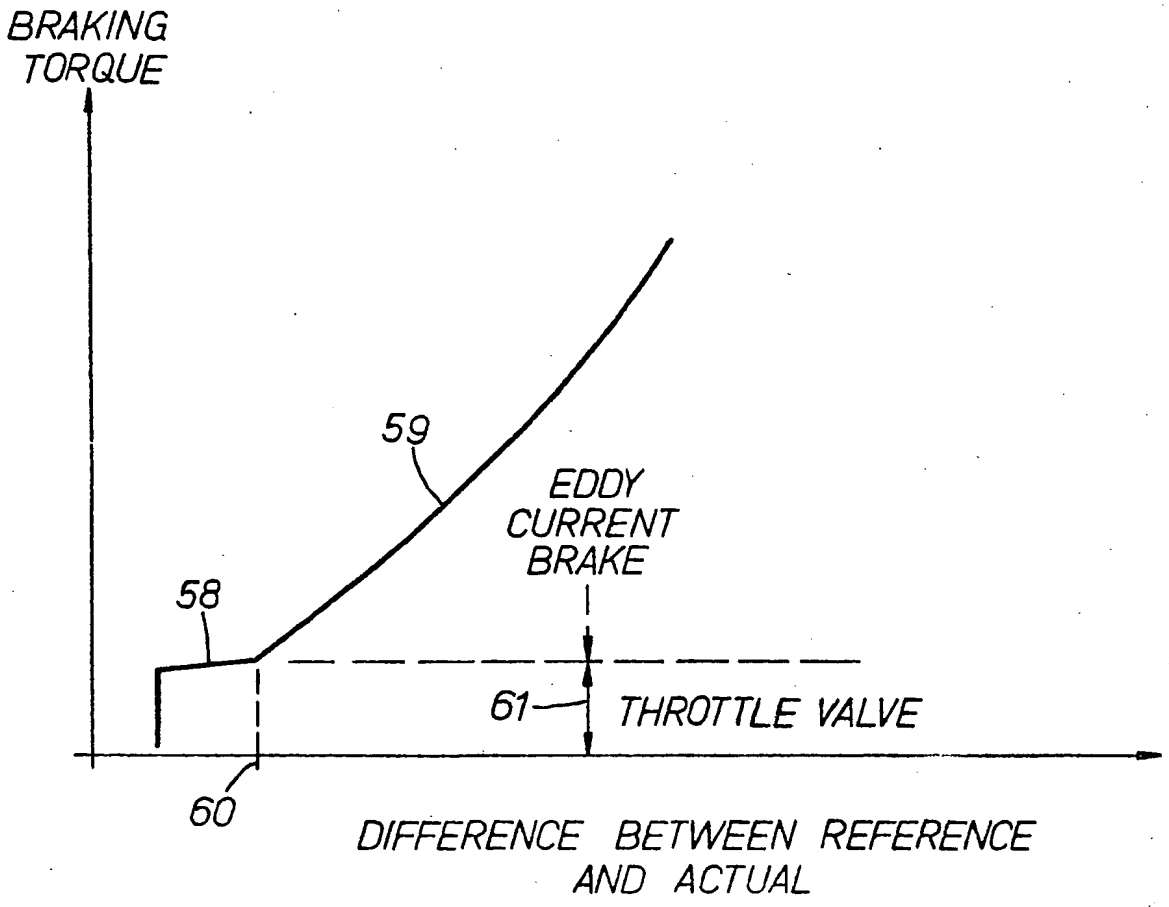

FIG. 4.

SPECIFICATION

Device for Regulating the Speed of a Vehicle

The invention relates to a device for regulating the speed of a vehicle.

Regulating devices are known for maintaining the vehicle speed at a set value by means of intervention in the power unit (for example controlling the fuel supply).

These devices are concerned with making it possible, in a simple manner, to maintain a particular running speed whilst under power. To control the speed of the vehicle whilst running downhill the driver must use the service brake or the deceleration device.

Retarders (cf. "Bremstechnisches Taschenbuch" produced by Wabco Westinghouse, 1976 edition, page 402) are used especially in commercial vehicles. They are operated, for example, when running downhill in order to ease the load on the service brake whilst keeping the vehicle at low speed. Retarders that are frequently used are, for example, an hydraulic brake or an air resistance brake. The purpose of retarders is, inter alia, to avoid prolonged operation of the service brake involving a high degree of wear.

The operation (switching on and off and adjustment) of the retarders must, however, continually be matched by the driver to the prevailing conditions, for example, to the gradient, load state etc.

An object of the invention is therefore to provide a device which in a simple manner makes it possible to relieve the driver of the need to control continuously the retarder and/or brakes of the vehicle under the circumstances described.

According to the present invention there is provided a device for regulating the speed of a vehicle fitted with a service brake and with an additional deceleration device for reducing the vehicle speed, in which a comparator is provided for comparing a reference value, depending on a preselected speed, with an actual value, depending on the vehicle speed, and the output signals of the comparator serve to bring into operation at least part of the deceleration device.

The invention has, inter alia, the advantage that, for example, when running down gradients, the vehicle speed is maintained at a present value or within a preset range without much work on the part of the driver.

The use of a controlled system makes it possible to use electronic components, especially those provided in anti-skid brake systems. Electronic components can advantageously be adjusted in a simple manner to different input and/or output quantities. Further, in a device according to the invention external control of a device supplying a reference speed value is possible. Radio transmitters, for example, in the zone of the route travelled, can transmit the permitted speeds to the vehicle, particularly where these are legal limits and these can be stored automatically.

The invention will now be explained in detail with reference to embodiments which are shown in the accompanying drawings, of which:—

Figure 1 shows a block diagram of a device according to the invention;

Figures 2 and 3 each show a more detailed diagram of an embodiment of the invention; and

Figure 4 shows a graph to illustrate the operation of the device shown in Figure 3.

Figure 1 shows a block diagram of a device according to the invention. The individual parts of this device are represented in the form of blocks and constitute an electronic embodiment of the invention. It is, however, also possible for at least some individual parts to be purely or substantially mechanical in nature.

The device shown in Figure 1 serves, for example in a lorry, to maintain the vehicle speed at constant value or following a given changing value. The speed of the vehicle is ascertained in a vehicle speed circuit 17, the output signal of which corresponds to the magnitude of the actual vehicle speed.

To obtain a signal dependent on the magnitude of the vehicle speed, a device 18 as proposed for use in anti-skid brake systems may advantageously be used. Usually, signals that correspond to the vehicle speed are used in an anti-skid system to detect the onset of skidding. Preferably, the device 18 is a part of an anti-skid brake system which is already present in lorries for controlling the service brake. Figure 1 indicates the use of the said device 18 by means of a broken line between the device 18 and the circuit 17.

The output signal of the circuit 17, to be regarded as the actual speed value, is compared in a comparator 9 with a reference speed value corresponding to a required speed for the vehicle. To obtain the reference value a circuit 2 for speed preselection is provided. In the simplest case the circuit 2 consists of a potentiometer at the tap of which a voltage corresponding to the preselected speed is established. The potentiometer may have a manual control.

The device provides, in an advantageous manner, for the control of the vehicle speed by means of an external radio transmitter or other data sender. Compulsory automatic speed control in accordance with the nature of the route travelled, for example, is thus possible. In Figure 1 this presetting of the speed to be observed is effected by a device 1 for speed presetting, which acts by means of a connection, shown by a broken line, on the circuit 2. The output signal (i.e. the reference speed value) of the circuit can thus be influenced selectively by the driver or by, for example, transmitters on the route travelled.

To carry out the comparison between reference value and actual value referred to above, the output of the circuit 2 is connected to an input 5 of the comparator 9 and the output of the circuit 17 to an input 6 of the comparator circuit 9. The signs "+" and "—" associated with the inputs 5 and 6 indicate that the said comparison in the

simplest case is achieved by forming the difference between reference value and actual value.

The comparator circuit 9 is so designed that, as the difference between reference value and actual value increases, signals are successively produced at its outputs 10, 11 and 12, and these serve to trigger several retarders 15, 14 and 13 of the lorry; for example, first the retarder 15, then the retarder 14 and finally the retarder 13 is switched on or triggered.

The retarders 13, 14 and 15 are parts of a deceleration device 16, which may in the simplest case consist of only one retarder.

The retarder 15, which is switched on when there is only a small difference between reference value and actual value, is an exhaust throttle on the diesel engine of the vehicle. The relevant throttle valve of the engine is switched on or off in a two-state manner. Accordingly the signal at the output 10 of the comparator circuit 9 is a two-state signal.

The retarder 14 is an adjustably controllable eddy current brake which may be on the transmission of the vehicle. The signal at the output 11 of the comparator 9 which controls the eddy current brake 14 is advantageously produced so that the eddy current brake 14 is operated only when the exhaust throttle retarder 15 has already been switched on. This means that starting at high speeds and thus large differences between the reference speed value and the actual speed value, as the actual vehicle speed drops, first of all only the action of the eddy current brake 14 is reduced and only after the brake 14 is completely released is the exhaust throttle 15 switched off.

The retarder 13 is an automatic gear-box system by means of which to reduce the vehicle speed a gear having a smaller transmission ratio is selected. Preferably the automatic gear-box system 13, which is triggered by the output 12 of the comparator 9, is operated only at high speed differences.

Although it is not shown, the decelerating device may also include a part of the auxiliary or parking brake of the vehicle. It is also possible, especially when very high speeds are to be lowered, for a part or all of the service brake to be triggered by an output of the comparator 9 in addition to the usual retarders. The retarders used for a device according to the invention are advantageously electromagnetically or electrically operable retarders, since these can be connected directly to the comparator without any intermediate elements such as transducers.

It is furthermore possible and advantageous to be able to control the selection and/or number of retarders triggerable by the comparator 9 in accordance with the prevailing conditions of the route travelled. For this purpose two auxiliary controls 3 and 4 are provided, of which one is adjustable in accordance with the load and the other is adjustable in accordance with the gradient of the route travelled. The auxiliary control 3 is connected to a corresponding input 7 and the auxiliary control 4 to a corresponding input 8 of the comparator 9. The auxiliary controls 3 and 4 are each advantageously adjustable with a scale which is calibrated in the particular quantity (load or gradient).

Figure 2 shows a simplified diagram of an embodiment of the invention. The device illustrated serves to control the speed of a lorry, an electrically controllable throttle valve 31 of an exhaust throttle retarder serving as control element.

The actual speed corresponding to the vehicle speed is produced in a circuit 19 for measuring the speed. The circuit 19 contains a differential d.c. amplifier 20 with d.c. negative feedback from the output of which a signal proportional to the vehicle speed can be obtained.

The amplifier 20 is fitted with a negative feedback circuit including a voltage divider. The output signal of a speedometer producing an output voltage proportional to speed is supplied to the non-inverting input of the amplifier 20. The output of the circuit 19 is connected to an input 21 of a comparator 22.

The reference value corresponding to the set or preselected speed is supplied to a second input 32 of the comparator 22 from the output 33 of a circuit 34 for preselecting the speed to be observed.

The circuit 34 contains a potentiometer 36 which is adjusted in accordance with the speed to be observed the tapping of the potentiometer 36 is connected to an inverting input of a differential d.c. amplifier 35, of which a non-inverting input is connected to a reference voltage (earth). The amplification on the inverting amplifier 35 described is determined by the ratio of the values of a feedback resistor to an input resistor.

It can be seen that to the inputs 21 and 32 of the comparator 22 there are respectively applied a signal that is proportional to the actual vehicle speed and a signal of the opposite polarity that is proportional to the speed to be observed. The comparator 22 contains a differential d.c. amplifier 23 acting as an inverting adder, of which the inverting input is connected via respective input resistors to the two inputs 21 and 32. These resistors accordingly form a summing circuit for the currents produced by the signals supplied to the inputs 21 and 32, and there is therefore produced at output 24 of the amplifier 23 a signal which corresponds to the difference between the reference value and the actual value.

The output 24 of the comparator 22 is connected to input 25 of a threshold value amplifier circuit 28. The threshold value amplifier circuit 28 contains a differential d.c. amplifier 27 connected to act as a Schmitt trigger, of which the inverting input is directly connected to the input 25 and of which the non-inverting input is directly connected to the tapping of a potentiometer 26 and through a positive feedback resistor to the output of the amplifier 27. A signal for switching on a throttle valve retarder 31

appears at the output of the differential amplifier 27 and thus at the output 29 of the threshold value amplifier circuit 28 only when the output signal of the comparator 22 exceeds a value dependent on the setting of the potentiometer 26. In this manner the output signal of the threshold value amplifier 28 exhibits a rectangular waveform as the amplitude of the output signal of the comparator 22 varies around the threshold value (as set by the potentiometer 26).

The output 29 of the threshold value amplifier 28 is connected to input 30 of the throttle valve 31, which can be switched on electrically, for exhaust throttling of the vehicle engine. The throttle valve 31 is thus always switched on when the actual value (vehicle speed) exceeds the reference value (preselected speed) by a certain amount set by the potentiometer 26, that is to say when the speed of the vehicle must be reduced. When the speed to be observed or a lower speed is reached, the throttle valve 31 is automatically switched off again. A hysteresis behaviour of the described control advantageously increases the freedom from hunting of the system.

Such a hysteresis behaviour is achieved in a simple manner by the positive feedback resistor between the output and the non-inverting input of the differential amplifier 27.

Another embodiment of the invention is shown in the simplified diagram of Figure 3. The device according to Figure 3, like the devices according to Figures 1 and 2, serves to control the speed, for example, of a lorry, by means of a retarder, but unlike the device in Figure 2, two retarders can be triggered.

Otherwise the device according to Figure 3 is constructed in individual parts like the device according to Figure 2. As regards the construction and method of operation of individual circuit components in Figure 3, reference is therefore made to the explanation of the corresponding circuit components of Figure 2.

To produce the reference value (preselected speed) there is provided in the device of Figure 3 a circuit 55, which contains a potentiometer 57 and a differential amplifier 56. The circuit 55 corresponds to the circuit 34 in Figure 2. Output 54 of the circuit 55 is connected to input 40 of a comparator I having the reference number 41. The output signal of a circuit 37, which contains an amplifier 38 and, corresponding to the circuit 19 in Figure 2, serves to produce the actual value (vehicle speed), is supplied to a second input 39 of the comparator 41. The resistors for setting the working point of the amplifier 38 are not shown but may be similar to those shown in Figure 2.

The comparator 41 is in principle similar to the comparator 22 in Figure 2. The comparator 41 has in addition, however, in the negative feedback path over amplifier 42, components, such as, for example, a by-pass capacitor, which ensure that the comparator 41, as regards the difference between reference value and actual value across the inverting input of the amplifier 42, has a behaviour that can be adjusted to the desired properties of the system by the selection of the said additional components. For instance, the addition of a capacitor to the feedback path will introduce some damping into the changes in the output signal of the comparator 41.

The output 43 of the comparator 41 is connected to input 44 of a switch 45 controlled by a control input 46. Output 47 of the switch 45 is connected to a control input 48 of a retarder 49 in the form of an eddy current brake. In this manner the connection between the output 43 of the comparator 41 and the control input 48 of the eddy current brake 49 can be switched on and off by means of the switch 45.

The control input 46 of the switch 45 is connected to an output 52 of a comparator II having the reference number 53. The comparator 53 is so designed that signals can be obtained from its output 52 that correspond to the output signals of the threshold value amplifier 28 in Figure 2, and in this instance serve to trigger a throttle valve 50 of an exhaust throttle retarder. For this purpose the output 52 of the comparator 53 is connected to the control input 51 of the throttle valve 50.

The controllable switch 45 is so designed that it conducts current only when there is a signal at its control input 46 that causes the throttle valve 50 to be switched on. This means that the eddy current brake 49 can be switched on only when the throttle valve 50 is also switched on.

Figure 4 shows a braking torque characteristic, which can be achieved by means of the device of Figure 3. The illustration shows the relationship of the braking torque to the difference, as measured in the device, between the reference value and the actual value. The braking torque characteristic has two curve parts 58 and 59. It is assumed that, starting at lower speeds and progressing to higher speeds, first of all the throttle valve 50 in Figure 3 is operated, the braking torque 61 of which is assumed as being almost constant, indicated by the approximately horizontal straight part 58.

The size of the difference between reference value and actual value at which the eddy current brake 49 is switched on, corresponding to the length of the curve part 58, is made so large that the throttle valve and the eddy current brake cannot be switched on or off simultaneously. The point according to value 60 at which the eddy current brake 49 is switched on is adjustable by means of the potentiometer 57 in Figure 3. The switch 45 in Figure 3 thus effects an additional safeguard against the eddy current brake 49 possibly being switched on too early. The line of the curve part 59 (for the eddy current brake) is adjustable within limits by the dimensioning of the electronic circuit components.

Claims

1. A device for regulating the speed of a vehicle fitted with a service brake and with an additional deceleration device for reducing the vehicle speed, in which a comparator is provided for comparing a reference value, depending on a

preselected speed, with an actual value, depending on the vehicle speed, and the output signals of the comparator serve to bring into operation at least a part of the deceleration device.

2. A device according to claim 1, wherein the deceleration device comprises several independently operable retarders and the comparator is so designed that it serves to bring into operation more than one of the retarders.

3. A device according to claim 2, wherein the comparator is so designed that if the actual value differs from the reference value by more than a predetermined amount, several retarders are brought into operation in succession by the output signals from the comparator.

4. A device according to claim 2 or 3, including additional means for controlling the comparator, which additional means influence the number of retarders that can be triggered by the comparator.

5. A device according to claim 4, wherein the additional means are dependent on the load state of the vehicle and/or the gradient of the route travelled.

6. A device according to any of the preceding claims, wherein the deceleration device includes an electrically or electromagnetically operable retarder of which the control input is connected to an output or outputs of the comparator.

7. A device according to any of the preceding claims, wherein the additional deceleration device includes an automatic gear-box control which is connected so as to be operable as a function of the output signals of the comparator.

8. A device according to any of the preceding claims, wherein the actual value, depending on the vehicle speed, is produced by means forming a part of an anti-skid device.

9. A device according to claim 8, wherein the anti-skid device is an anti-skid device provided for controlling the service brake.

10. A device according to any of the preceding claims, wherein the comparator is so designed that it produces output signals influencing the speed of the vehicle only when the difference between reference value and actual value exceeds a predetermined hysteresis threshold value.

11. A device according to any of the preceding claims, wherein the output signals of the comparator are also connected to bring into operation a braking device that can be used as an auxiliary brake.

12. A device according to any of the preceding claims, wherein the reference value follows a preselected change of speed.

13. A device according to any of the preceding claims, wherein the output signals of the comparator are also connected to bring into operation a part of the service brake.

14. A device according to any of the preceding claims, including receiving device for the automatic receipt of a speed signal which is connected to the comparator as the reference value.

15. A device according to claim 14, wherein the receiving device is arranged to receive radio signals or inductively transmitted signals which are modulated in accordance with transmitted speed signals.

16. A device for regulating the speed of a vehicle substantially as described herein with reference to Figure 1, Figure 2 or Figures 3 and 4 of the accompanying drawings, or modified as described herein.

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